Gravity worms in the prospecting of epigenetic gold deposits: Example from the Northern Fennoscandian Shield

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Background

Gravity worms (Hornby et al., 1999) are representations of the maxima of total horizontal gradients processed at different upward continuation levels (Figure 1). This poster shows gravity worms of the dataset collected by the Geological Survey of Finland. The dataset consists of 19 273 ground measurements with site separation of 0.5 - 2 km.

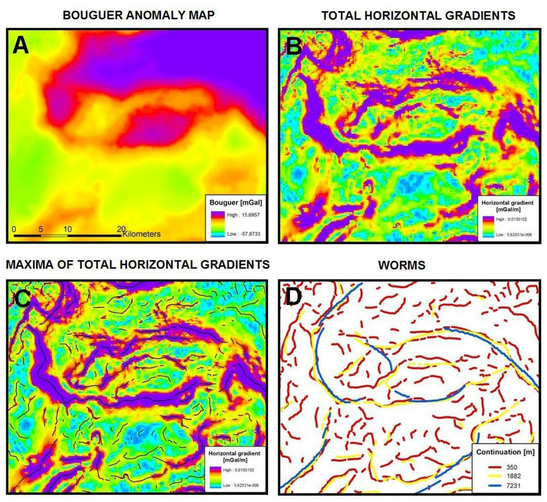

Figure 1. The concept and processing stages of gravity worms.

The study area (Figure 2) covers the central part of the 2.4 - 2.0 Ga Central Lapland Greenstone belt that hosts numerous gold occurrences of varying type and size.

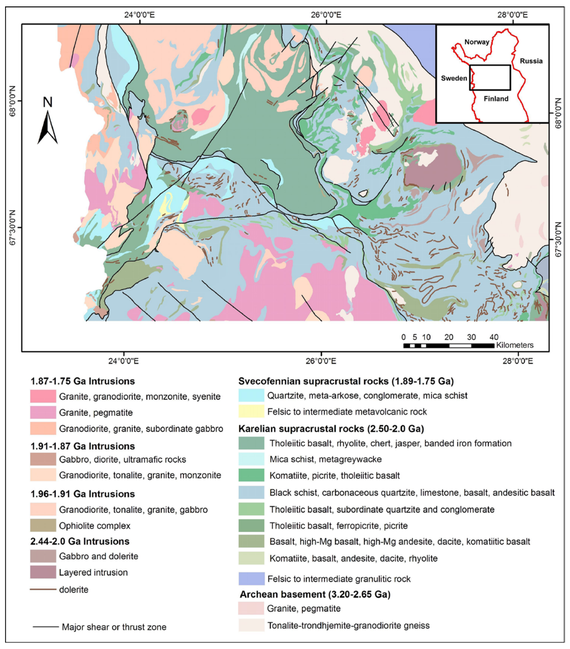

Figure 2. Geological map of the study area.

The majority of the gold occurrences fall into the orogenic gold category but also Iron Oxide-Copper-Gold (IOCG) and paleoplacer types are known within the region (e.g. Eilu et al., 2007). The largest known deposit in the area is the Suurikuusikko orogenic gold deposit with current resources exceeding 5 million ounces Au. The largest IOCG type resources are in the Hannukainen deposit with ca. 200 000 ounces of gold.

Spatial correlation between gravity worms and gold occurrences

Processed gravity worms display a striking spatial correlation with known gold deposits and prospects (Figure 3). The correlation is quantified here as W+ by calculating the natural logarithm of the normalized density following the weights-of-evidence method (e.g. Bonham-Carter, 1994). Gravity worms were described as a proximity map classified into 16 classes using quantile method in GIS.

$$W^{+} = \ln \frac{N(B_i \cap D) / N(D)}{A(B_i) / A(T)} \qquad (1)$$

where

$N(B_i \cap D)$ = number of gold occurrences within a map class i
$N(D)$ = total number of gold occurrences within the study area
$A(B_i)$ = area of map class i
$A(T)$ = total area of the study area

Figure 4 shows the proximity map of the worms. The 119 yellow points representing the gold occurrences were used for the weight calculation and the 983 grey random points were used for comparison. The results of the weights calculations are shown in Figure 5 and the prospective area based on the weights calculation is shown in Figure 6. The calculation shows that, while the calculated worms cover only 30% of the total area, 70 % of the known gold occurences lie within this area i.e. within 675 meters from the gravity worms.

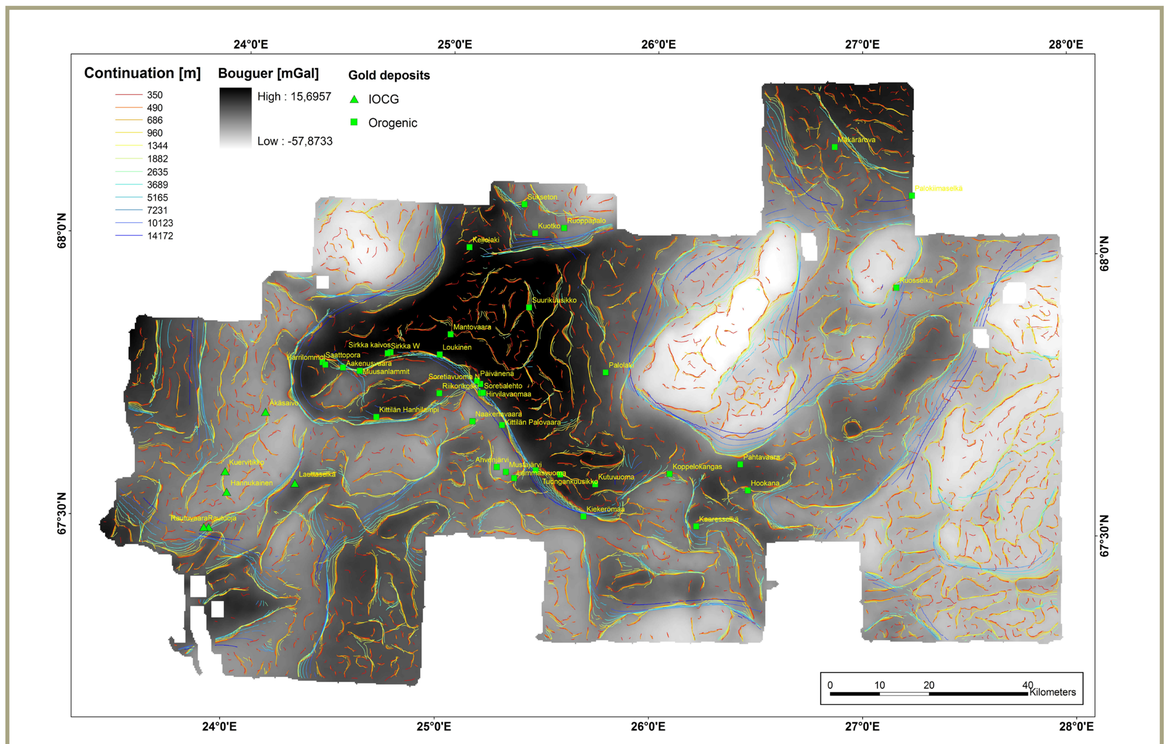

Figure 3. Bouguer anomaly data and the processed gravity worms.

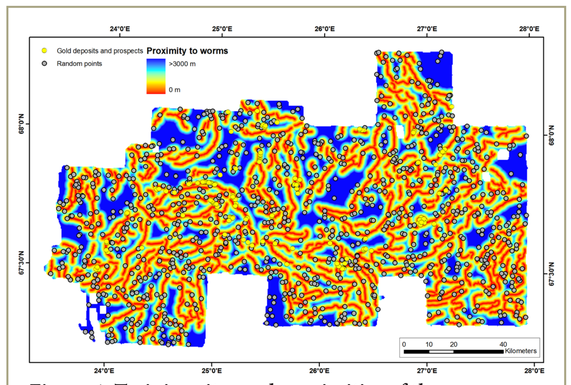

Figure 4. Training sites and proximities of the worms.

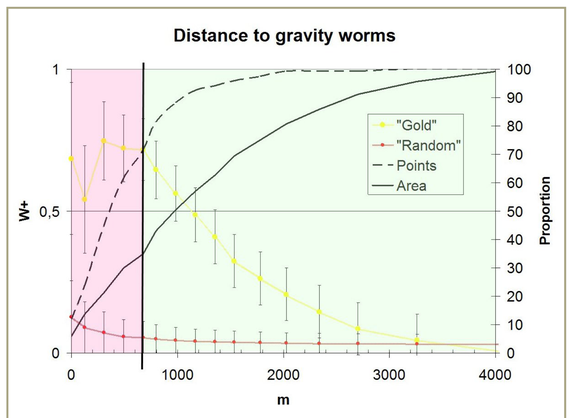

Figure 5. Results of the weights calculations.

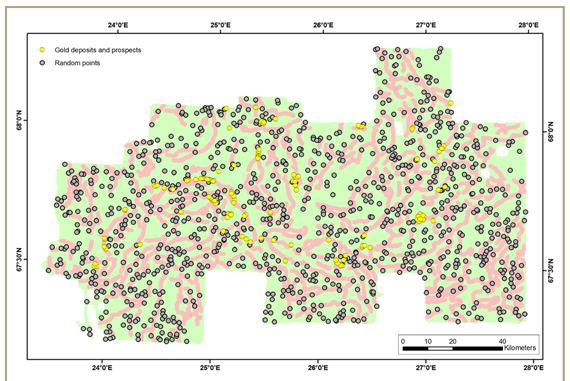

Figure 6. Prospective area for gold based on the worms.

References

Bonham-Carter, G.F. 1994. Geographic Information Systems for Geoscientists – Modelling with GIS. Computer Methods in the Geosciences 13. Pergamon, Oxford, 398 p.

Eilu, P., Pankka, H., Keinänen, V., Kortelainen, V., Niiranen, T., Pulkkinen, E., 2007. Characteristics of gold mineralisation in the greenstone belts of northern Finland. In: Gold in the Central Lapland Greenstone Belt. Geological Survey of Finland. Special Paper 44. Espoo: Geological Survey of Finland, 57-106.

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